Photoemission Line-Shapes and Dispersion Relations in the Superconducting State of BISCO /Bi$_2$Sr$_2$CaCu$_2$O$_8$/

A.V. Fedorov[‡], Y.-D. Chuang[‡]

A.D. Gromko, Z. Sun, J. Douglas, J.D. Koralek, D.S. Dessau

— Physics Department, University of Colorado, Boulder —

Y. Aiura, Y. Yamaguchi, K. Oka

— AIST —

Yoichi Ando

— CRIEPI —

[‡] : AVF&YDC presently at Advanced Light Source, LBNL

Motivation:

detection of Bonding and Anti-bonding bands in BISCO /bi-layer splitting/
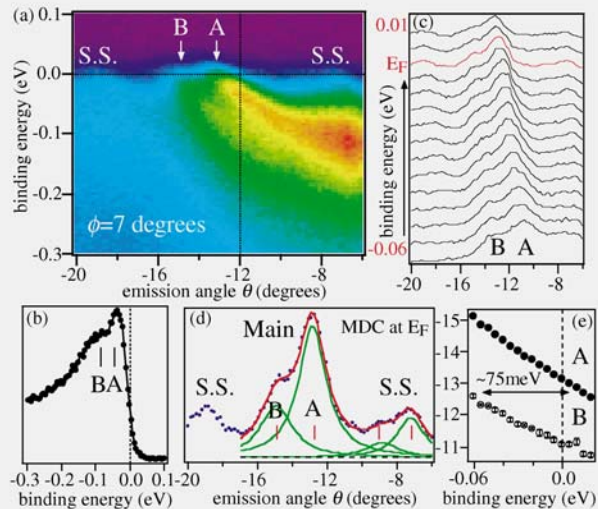advanced their understanding and generated questions about "Peak-Dip-Hump" picture

FIG. 2 (color).   (a) False color plot of E vs emission angle θ for the $\phi = 7°$ cut [white line in Fig. 1(a)]. (b) EDC at $\theta = -12°$ from panel (a) (vertical black dashed line). Two distinct features, A and B, can be clearly seen in this EDC. (c) MDC ... ... +10 to −60 me... ... e dots), includin... ... shows the fittin... ... (green lines) p... ... re band (green lines) on top of a linear background (black dashed line). (e) The energy dependence of the θ value of MDC peaks A (closed circles) and B (open circles). The error bar from the fitting is smaller than the symbol size.

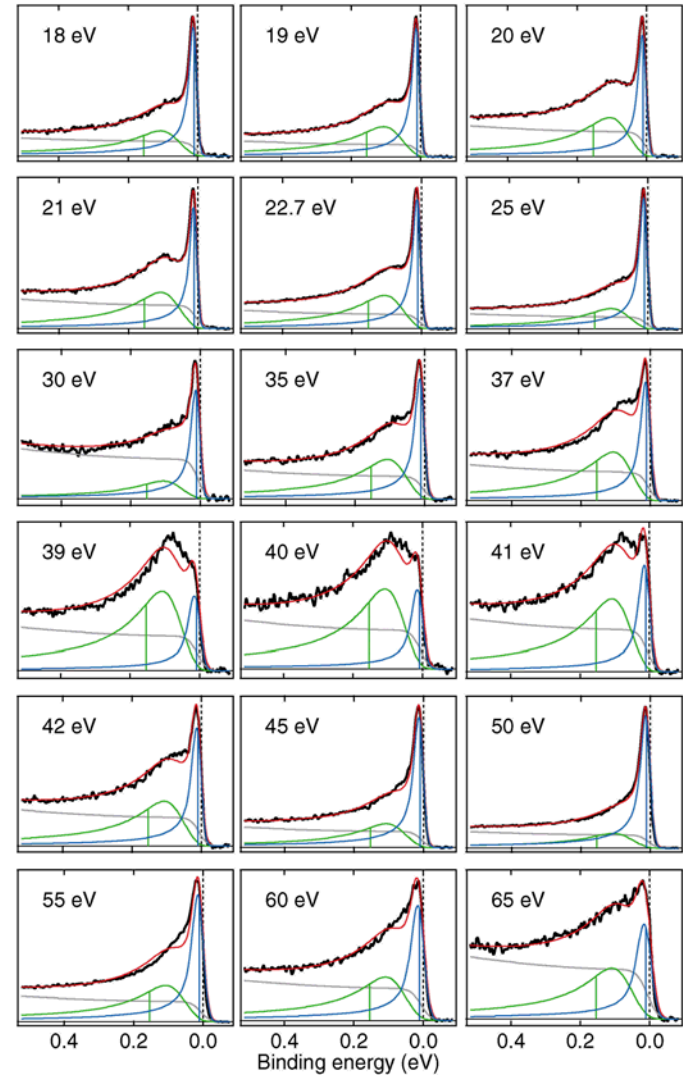Y.-D. Chuang et al., PRL 87, 117002 (2001)

FIG. 2 (color).   The $(\pi, 0)$ photoemission spectra from the superconducti... ... e for differ-ent excitation ... ... xperimental data and the ... ... of a fitting procedure described in the text.

A.A. Kordyuk et al., PRL 89, 77003 (2002)
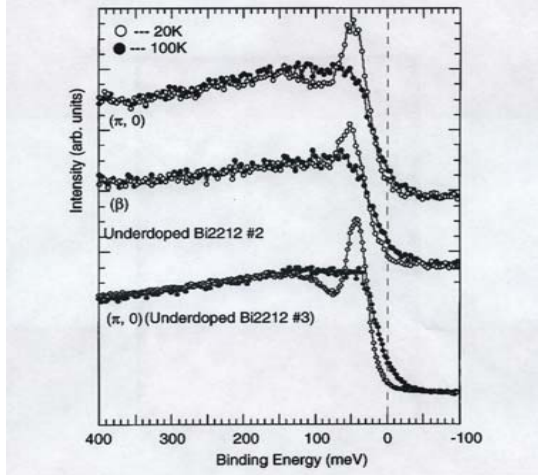
PDH as a signature of strong coupling

FIG. 2. ARPES data from normal and superconducting states of underdoped Bi2212 near $(\pi, 0)$. As illustrated in the inset of Fig. 1(β) is the Fermi surface crossing point along the $(\pi, 0)$ to (π, π) line and it is very close to $(\pi, 0)$. The upper two sets of curves were recorded with 35 meV energy resolution while the low set of curves was recorded with 20 meV energy resolution.
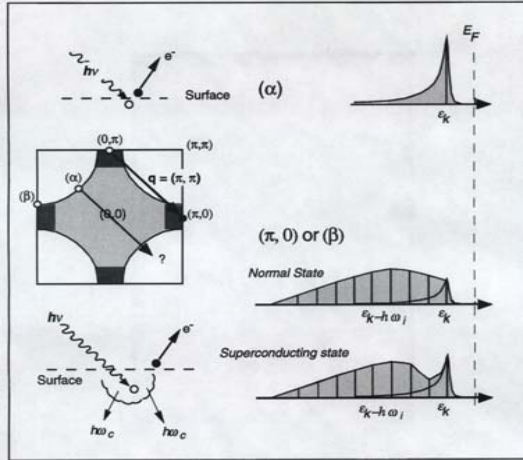

FIG. 3. Illustration of photoemission process and spectral shape in systems with weak (α) and strong couplings [(β) and $(\pi, 0)$]. The Fermi surface picture depicts the phase space considerations for the coupling between the quasiparticle and collective excitations near (π, π). The light shaded area indicates the filled states, and the dark shaded area indicates the flat band region near the Fermi level.
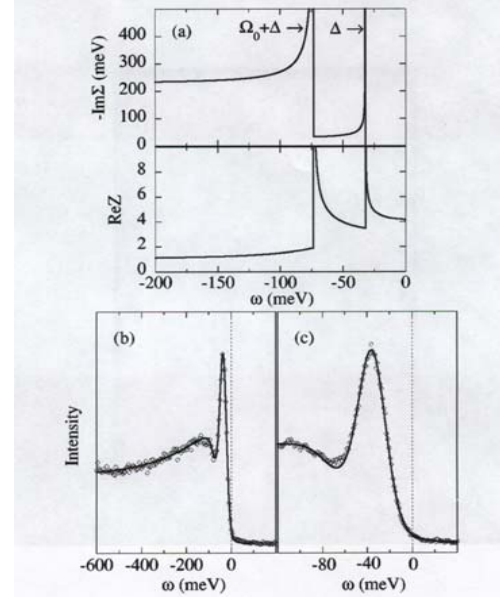
FIG. 3. (a) ImΣ and ReZ at $(\pi,0)$ from Eqs. (2) and (3) ($\Gamma_1=200$ meV, $\Gamma_0=30$ meV, $\Delta=32$ meV, $\Omega_0=1.3\Delta$). Comparison of the data at $(\pi,0)$ for (b) wide and (c) narrow energy scans with calculations based on Eqs. (1)–(3), with an added step edge background contribution.
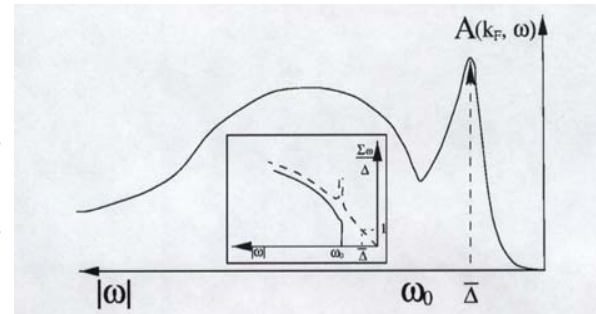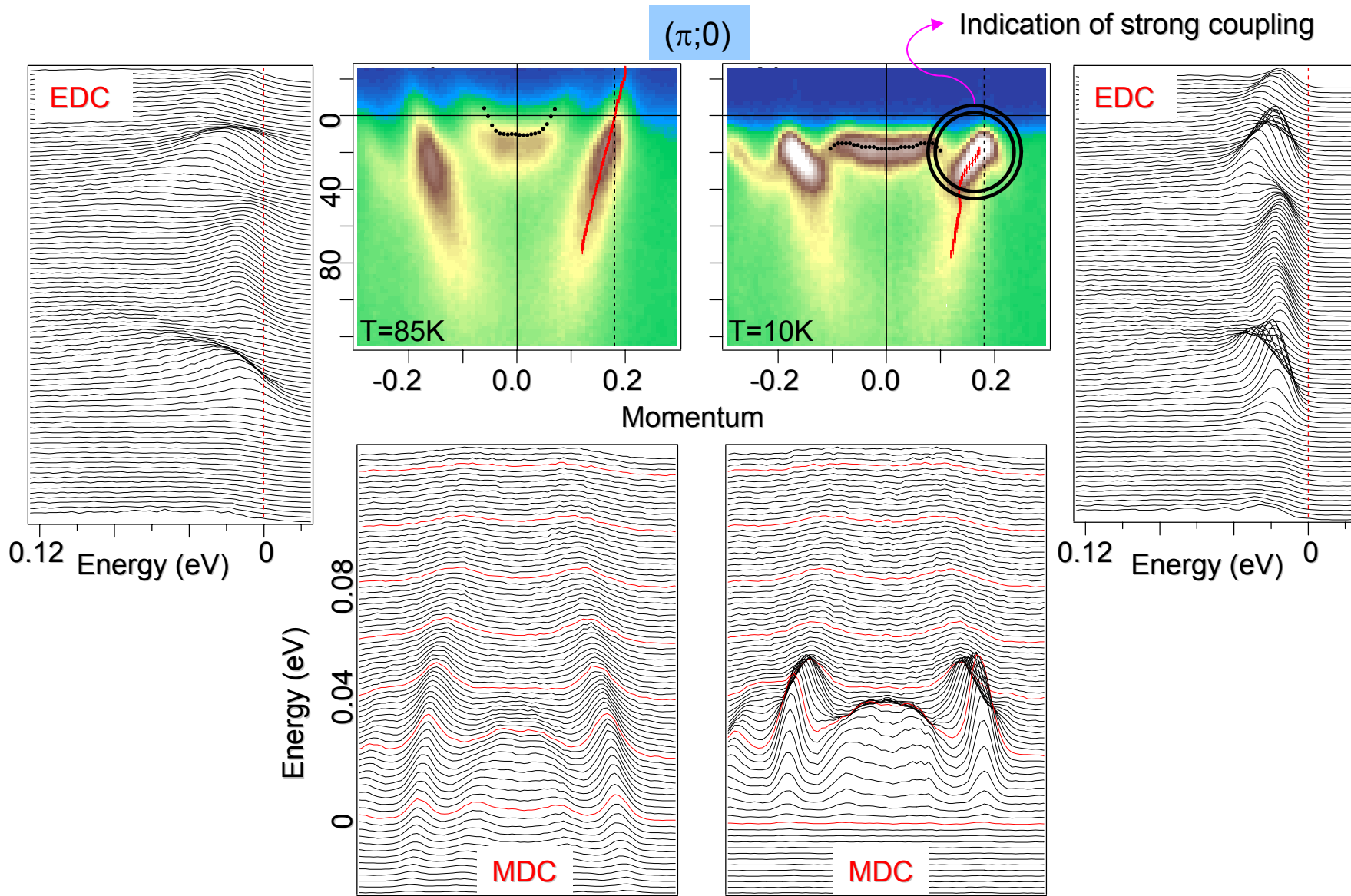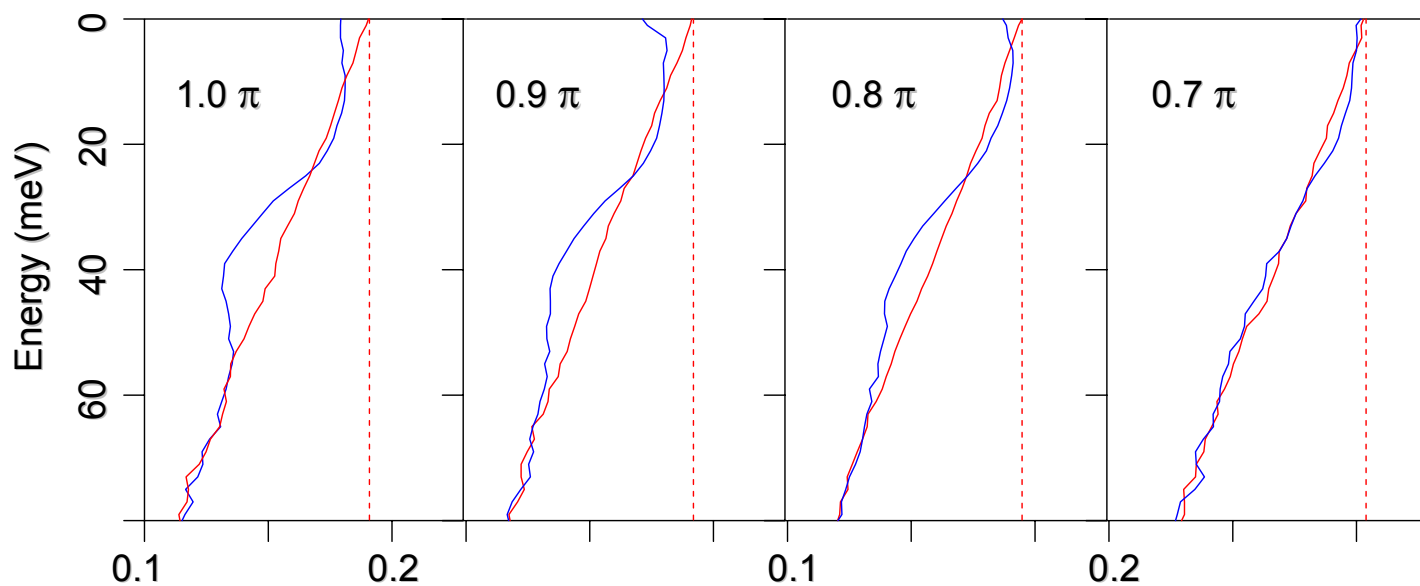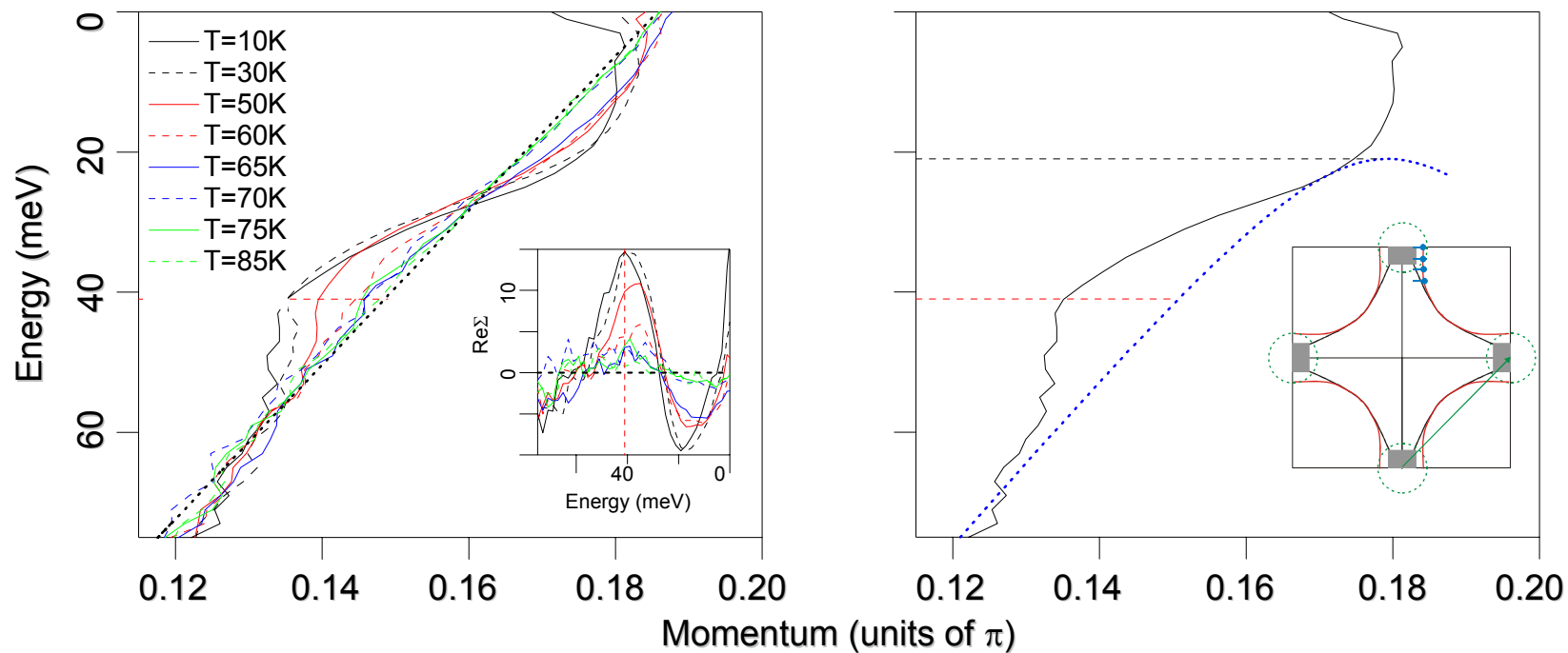
FIG. 2. Same as in Fig. 1 but at strong coupling. The resonance and onset frequencies are presented in the text. The spin resonance frequency $\Omega_{res} \propto \xi^{-1}$, is equal to the distance between the measured gap $\overline{\Delta}$ and the dip frequency ω_0. The hump frequency differs from $\overline{\Delta}$ roughly by $\xi^{0.7}$.
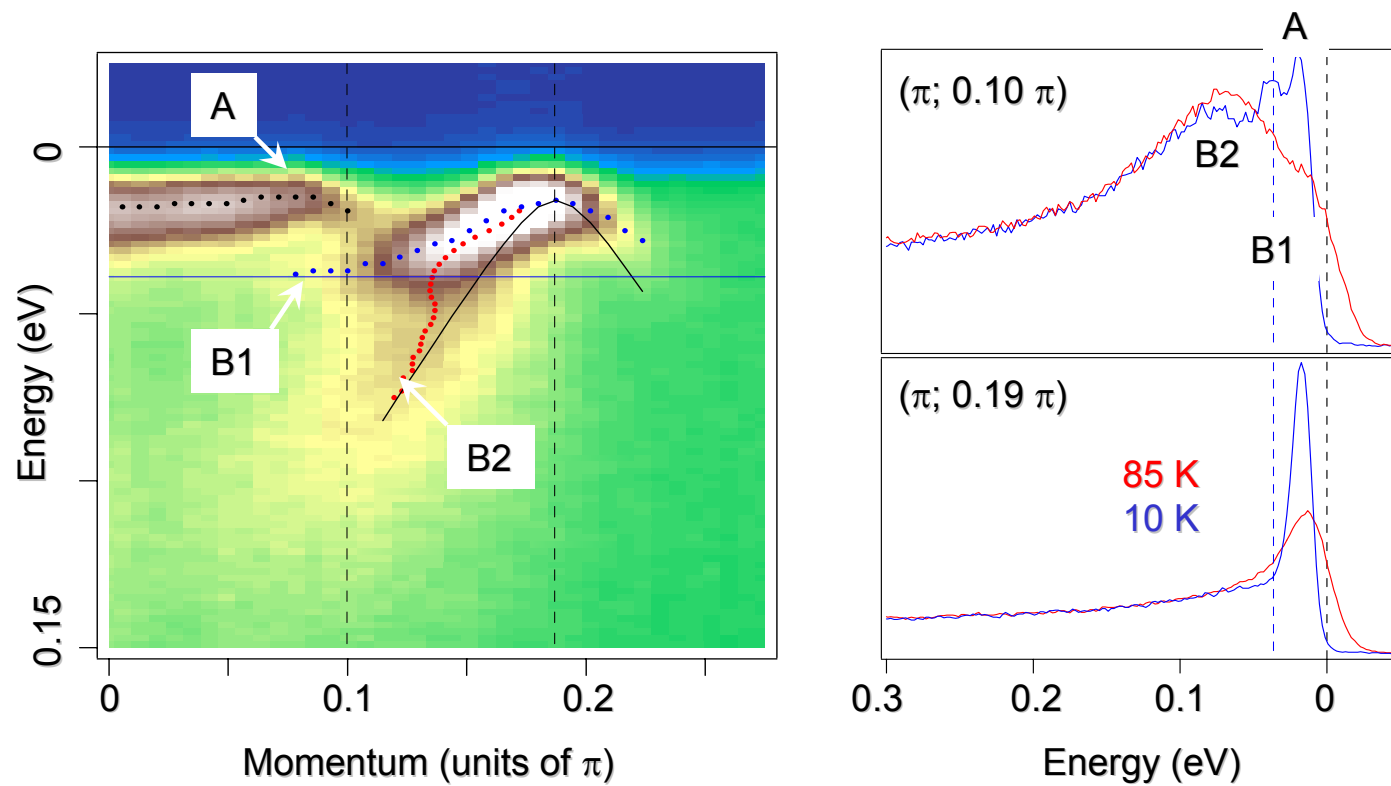
Overdoped sample /T_C=58 K/

$(\pi;0)$

Indication of strong coupling

EDC

T=85K

T=10K

EDC
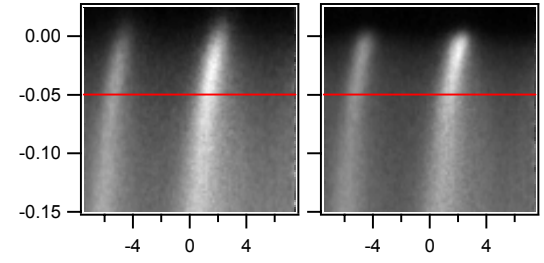
Momentum

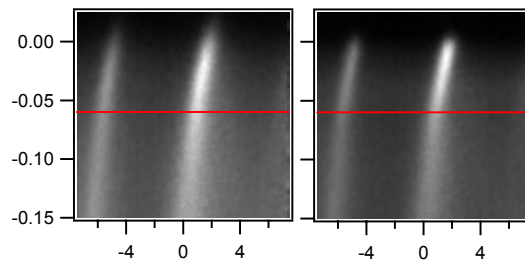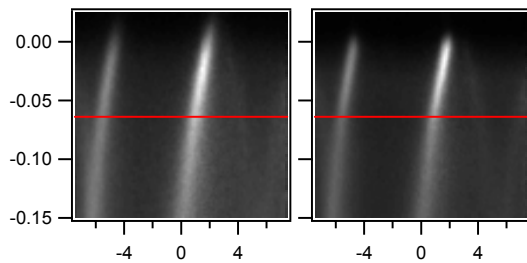0.12 Energy (eV) 0

Energy (eV)

0.08

0.04
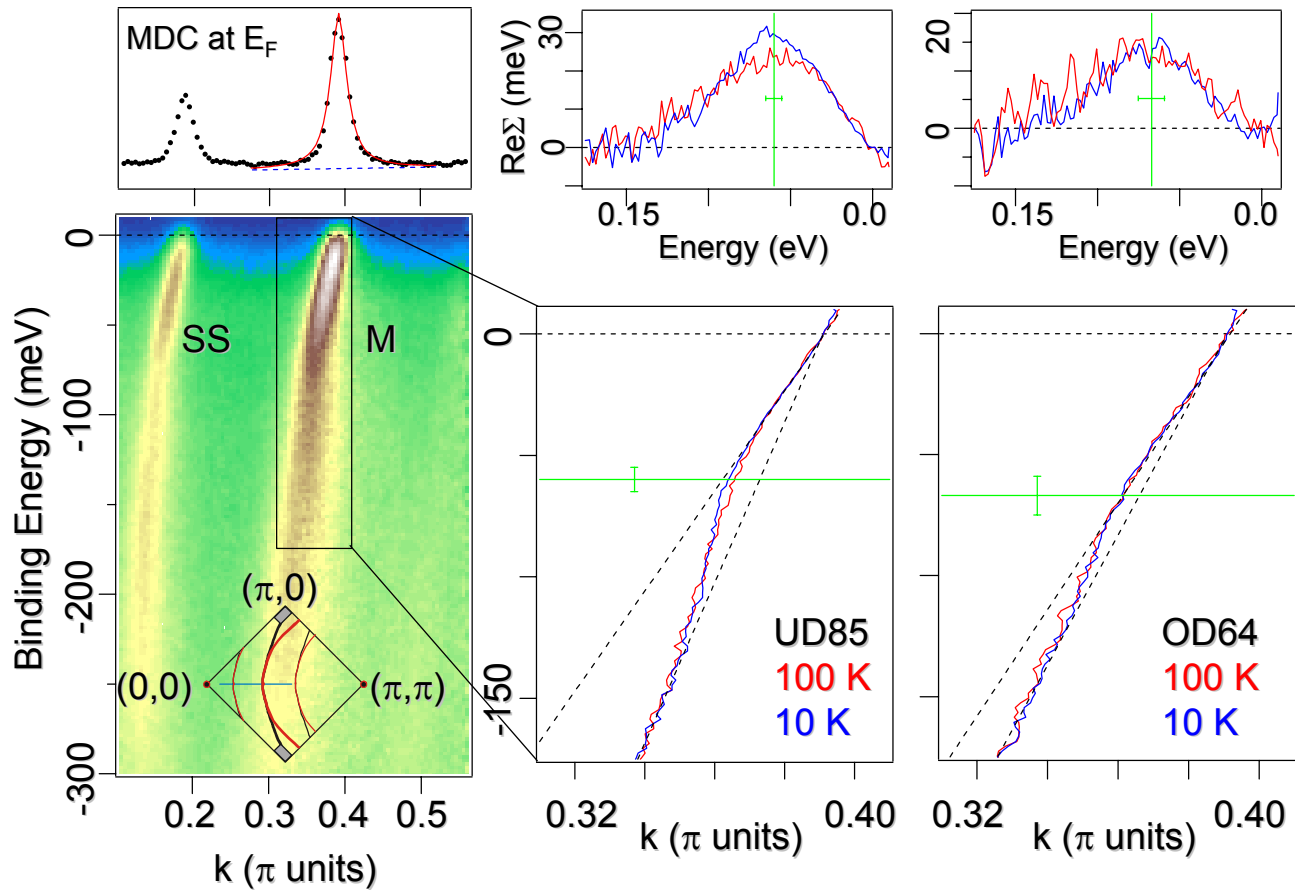
0

MDC

MDC

0.12 Energy (eV) 0
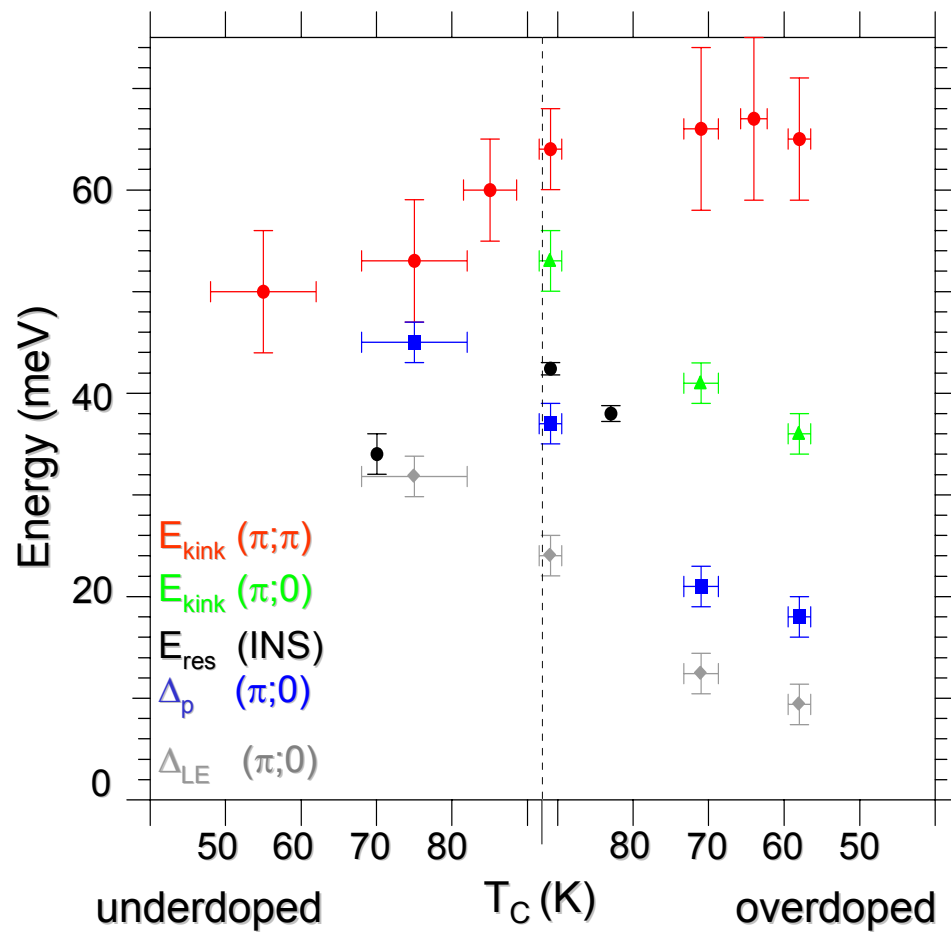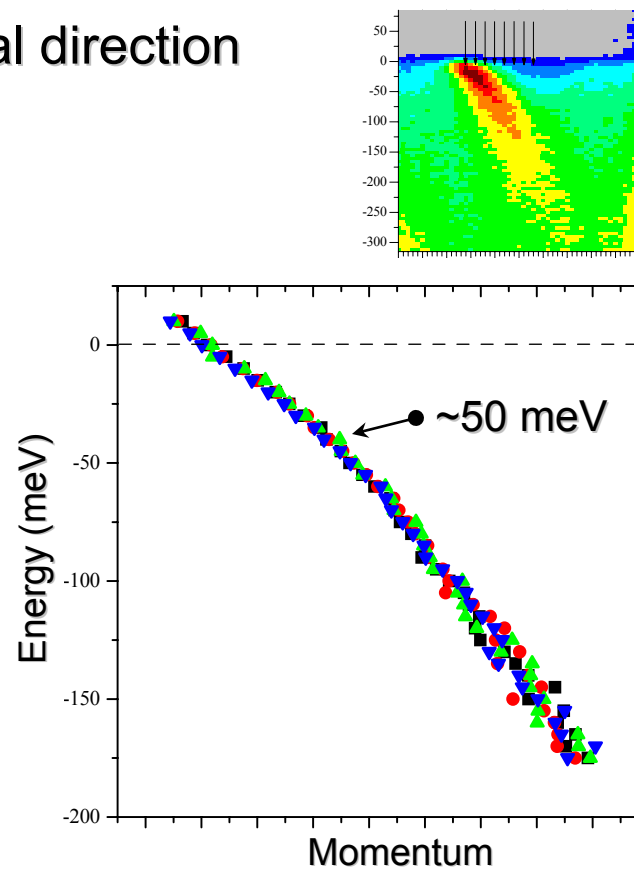
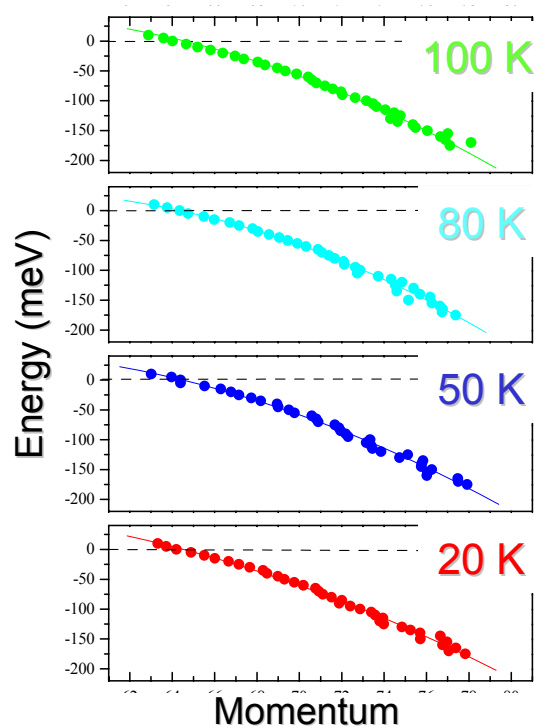# Temperature and Momentum Dependence, (π;0)

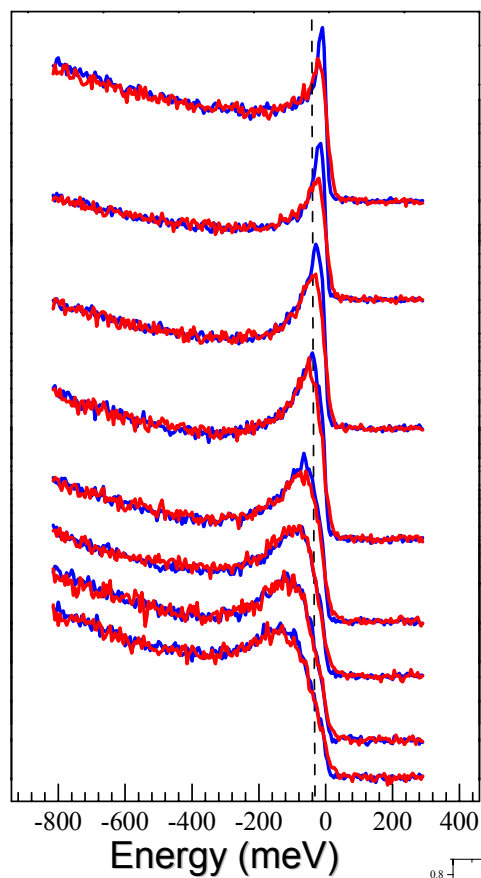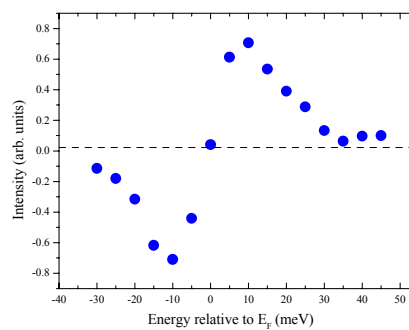# Peak-Dip-Hump

Nodal direction

Summary of the energy scales

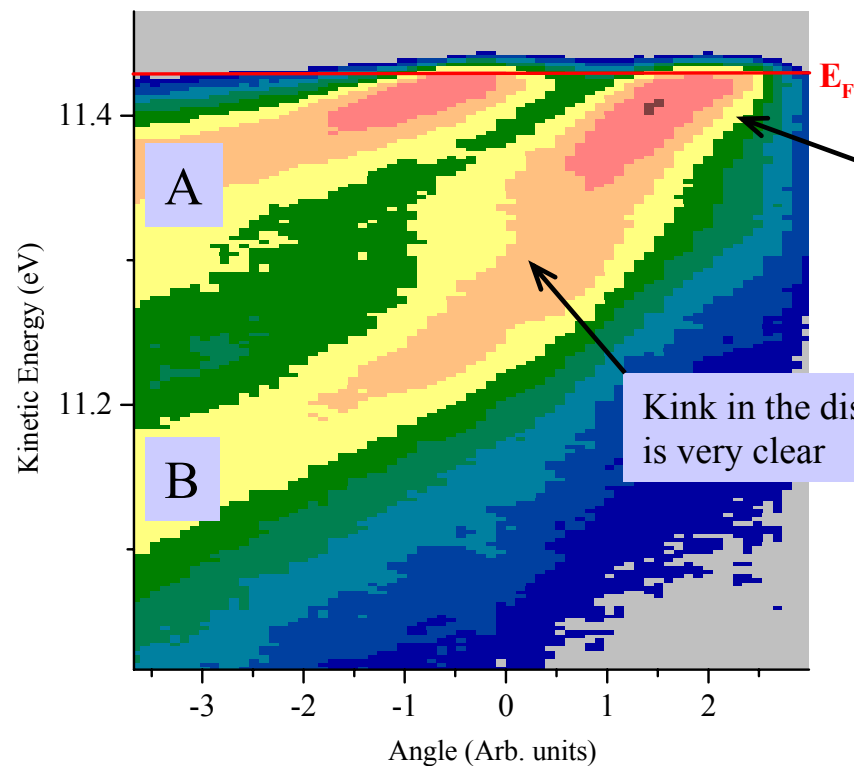# Single-layer BISCO, nodal direction
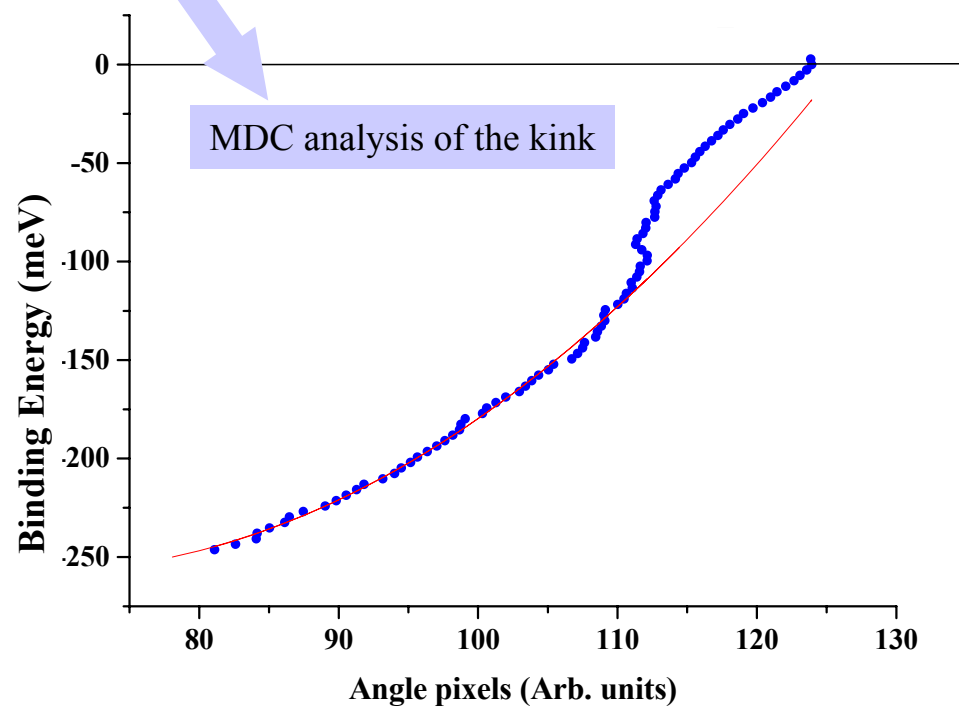
EDC and MDC, temperature dependence
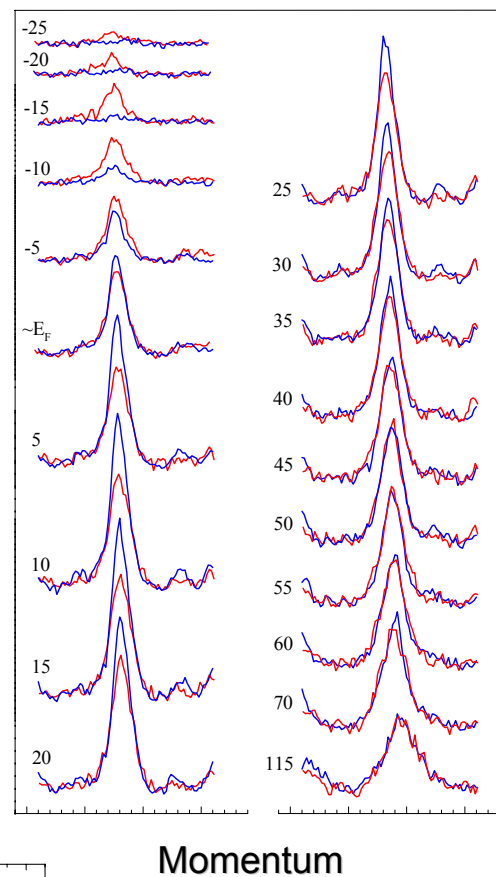
2H-TaSe$_2$ below CDW transition

Kinetic Energy (eV)

11.4

11.2

A

B

E$_F$

-3   -2   -1   0   1   2

Angle (Arb. units)

Note two well-resolved bands
/bi-layer splitting/ crossing the
Fermi level

Kink in the dispersion
is very clear

MDC analysis of the kink

Binding Energy (meV)

0

-50

-100

-150

-200

-250

80   90   100   110   120   130

Angle pixels (Arb. units)